

Image processing system and method

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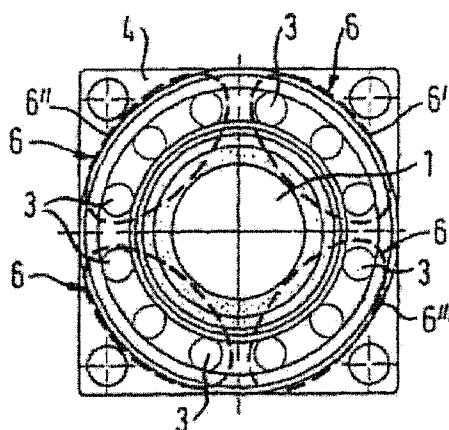
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Abstract of corresponding document: EP 1158460 (A2)

The method involves illuminating the object with light emitting elements, detecting the illuminated object with an acquisition unit and evaluating at least part of the detected image. Different groups of transmission elements are successively activated in a learning process. A group is selected as a reference group for which the best image is produced for object detection. The elements of the selected group are driven to detect the learned object. The method involves illuminating the object with a number of light emitting elements (3), detecting the illuminated object with an acquisition unit and evaluating at least part of the detected image. Different groups (6) of transmission elements are successively activated in a learning process and a group selected as a reference group for which the best image is produced for detecting the object.; The transmission elements of the selected group are driven to detect the learned object after the learning process. Independent claims are also included for the following: an optoelectronic device for image processing and the use of the inventive method and arrangement for pattern recognition and image enhancement.

FIG. 1



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The instant invention concerns a method to the image processing, illuminated with which an object becomes by a variety of light sending transmitting elements, which illuminated object of a receiving unit detected will and which becomes of the receiving unit detected image of the object evaluated. Further the invention is directed on an optoelectronic device to the image processing with a variety of light sending transmitting elements, which are for lighting up one object formed and arranged which can be recognized, and with a detecting unit, with which the illuminated object is convertible detected and into a digital image.

Methods that initially mentioned type can become for different objects used. Conventional objects are the pattern recognition, picture improvement, segmentation, classification, objects to the determination of measures in an object scene (quality inspection), Lageprüfung or recognition of processing errors, z. B. of surface defects. The picture version usually camera systems become used, so that the object and/or. Sample lighting a substantial roller plays. Classical image processing systems cover for example a CCD camera, whereby the illumination of the object becomes either with ambient light or, illuminated to the signal gain, with external light sources. Newer systems are for example than CMOS-based camera systems formed, which are very compact formed and can an integrated active illumination have. The illumination of the object made thereby over this integrated illumination usually from relative short distance.

The illumination can be thereby for example as ring lighting around an usually used lens formed and become for example with semiconductor radiation sources realized. These can light up the object direct or with upstream optics. By the annular illumination the object becomes from many directions simultaneous illuminated, which can prove depending upon object for object recognition, for example with shiny objects, in particular during a presence examination as adverse.

It is an object of the instant invention to train a method and an apparatus that in such a way initially mentioned type that independent becomes by the type of the detected object and the object posed by as good a detection of a predetermined object as possible achieved.

Those the method respective object becomes according to invention on the basis of a method that initially mentioned type by the fact dissolved that in a training procedure successively different in each case groups of the transmitting elements become emitting light the driven that certain on the basis predetermined selection criteria the group of the transmitting elements becomes as group of references, with whose drive during the training procedure for the recognition of the object at the best suitable image detected become, and that become driven after terminating the training procedure seizing the trained object the transmitting elements of the group of references.

That the apparatus respective part of the object becomes according to invention on the basis of an apparatus that initially mentioned type by the fact dissolved that the transmitting elements are in different groups summarized, whereby the transmitting elements of a group are controllable common in each case, however separate of the transmitting elements of the other groups to emitting light.

Made according to invention thus before the actual object collection and/or. - recognition in the so called object collection enterprise a smart training procedure. During the training procedure targeted not all transmitting elements become simultaneous driven, but simultaneous only in each case the transmitting elements of a group of transmitting elements driven become, whereby each group covers only a subset of the entire number of the transmitting elements. The drive of the different groups made again successively. By the fact achieved becomes that depending upon geometry or surface characteristic, for example different images result rem eating ion behavior, the illuminated object, which depending upon selected group of transmitting elements different, the object characterizing features to possess.

After successively all groups became driven, that group of the transmitting elements becomes certain as group of references, with whose drive for the recognition of the object at the best suitable image detected becomes. In the normal object collection enterprise then the straight transmitting elements of the group of references of driven become, there with these the probability of recognition of the object optimum are and/or seizing the object. the characteristic features of the object at the best detected to become to be able.

For example as with the state of the art always all annular arranged transmitting elements if driven become, then it can lead to the fact that almost extinguished for the object characteristic shadows become by the symmetric, annular illumination and thus z. B. the probability of recognition for the object reduced becomes. With the invention process the shade throw can become however maximized by suitable grouping of the transmitting elements, so that also the probability of recognition for the object and/or. for the characteristic features of the object maximized becomes.

After a favourable embodiment of the invention each group covers an accurate transmitting element. The transmitting elements can become thereby for example corresponding their arrangement sequentially successively single driven, so that with an annular array of the transmitting elements after terminating the training procedure an illumination of the object from all possible different angles made. On the basis the predetermined selection criteria the subsequent transmitting element selected and stored becomes, for that the probability of success for the recognition of the object and/or. its characteristic features is highest. In principle the transmitting elements can become also in arbitrary order driven, there all in each case during the training procedure of detected images and/or. characteristic features of the images stored and to the selection of the most suitable group and/or. in this case of the most suitable transmitting element after completing the training procedure compared with one another become. On the order of the drive of the single groups it does not depend therefore during the training procedure.

It is also possible that each group covers at least a transmitting element, in particular several transmitting elements. The groups can become thereby overlapping or lap-free selected, D. h. in each case contain transmitting elements, which are contained of exclusive transmitting elements, which are not contained in other groups in other groups either also or contain. Also in this case the sequence of the drive of the respective groups is not relevant during the training procedure.

After an other favourable embodiment of the invention the group of the transmitting elements becomes selected as group of references, with whose drive the detected image of those the features most characteristic possesses the object and/or with their drive a characteristic feature or several characteristic features of the detected object optimum are, for example an extreme value assumes. As characteristic features can become for example shade throw, reflectances and/or contrast transitions evaluated.

Thus it is for example possible that the group of the transmitting elements becomes selected as group of references, with whose drive the detected image the highest contrast transitions possesses. Which feature becomes used as predetermined selection criterion for the selection of the group of references, determined can become and depends in particular on the embodiment of the object which can be seized by practical trials.

After an other preferable embodiment of the invention the exclusive transmitting elements of the group of references become driven seizing the trained object in the object collection enterprise. Thus the time used for seizing the trained object in the object collection enterprise becomes minimized, whereby optimized by the use of the group of references the probability of recognition becomes simultaneous - bottom consideration of the minimized detect time -.

If the probability of recognition is to become still other increased, then it is possible after an other preferable embodiment of the invention that become certain during the training procedure in order of their suitability for the recognition of the object additional downstream groups of references and that to recognizing the trained object after heading for the transmitting elements of the group of references the transmitting elements that immediate downstream group of references and if necessary. the transmitting elements of other downstream groups of references of driven become. This is in particular meaningful if for example different objects result in the same group of references of similar images or characteristic features in the case of lighting up with transmitting elements. In this case it can be meaningful to determine and store other downstream groups of references during the training procedure and these additional for the group of main references during the object collection enterprise to use. In this way will the period for the recognition of the object extended, simultaneous becomes however the probability of recognition still other increased.

After an other favourable embodiment of the invention the detected image of the object becomes checked on at least partial correspondence with at least a predetermined reference image. With not sufficient correspondence of the detected image of the object with the predetermined reference image the detected image can become on at least partial correspondence with few an other predetermined reference image checked. In this way the current in each case examined object with a variety of predetermined, stored reference images can become compared, until a correspondence with one of the predetermined reference images becomes recognized. Existed only a single predetermined reference image, which is to become recognized with the invention process, then the object becomes as not recognized classified after not sufficient correspondence.

Preferred one becomes with a sufficient correspondence an object recognition signal generated, especially an object recognition signal characteristic for the recognized object becomes generated when being present a variety of allowable predetermined objects.

With one erfindungsgemäss formed optoelektrischen apparatus is it by the summary of various transmitting elements in different groups, which are controllable separate in each case to emitting light, possible, to light up a pattern which can be recognized in such a way that the image of the object of optimum features, for example optimum contrast ratios and/or geometry characteristics, as for example shade throw by high profiles, detected of the detecting unit due to the remitted light, generated. Beyond that informations can be won by an optimized illumination, which the alignment of the detecting unit, in particular an used camera, concerning the object to support.

The optoelectronic device can cover a preferred optical unit for illustrating the object on the detecting unit, whereby this optical unit can be in particular more adjustable, in order to be able to adjust thereby different object distances.

Also the illumination of the object can take place via the transmitting elements by means of upstream optics or direct via the transmitting elements.

Preferred ones are the transmitting elements concentric in particular around the optical axis of the detecting unit, annular in particular around the optical unit of the detecting unit around arranged. In principle however any arrangement of the transmitting elements is possible, by which the object can become from different angles illuminated.

The transmitting elements are preferred in a plane arranged, vertical in particular to the optical axis of the detecting unit and/or. the optical unit of the detecting unit arranged is.

Further an evaluating unit is favourable for examining the detected image of the object for at least partial correspondence with at least a predetermined reference image provided. This can be as microprocessor formed in particular.

Other favourable embodiments of the invention are in the Unteransprüchen indicated.

The invention becomes subsequent reference bottom on the basis the object "pattern recognition" on the drawing more near described. This does not represent limitation of the invention, which is more applicable for a variety of different tasks of image processing, from which some exemplarily initially mentioned is. In the drawing show:

Fig. 1 a front view on formed a according to invention apparatus and

Fig. 2 a longitudinal section by one erindungsgemäss formed apparatus.

Fig. 1 shows an optical unit 1, with some pattern or an object to a detecting unit 2 (Fig. 2) for example a CCD chip or a CMOS-based photosensitive receipt component imaged will can.

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Around the optical unit 1 around is a variety of transmitting elements 3 arranged formed as light emitting diodes, by which of the optical unit a 1 can become on the detecting unit 2 imaged patterns illuminated.

The transmitting elements 3 are annular and in a plane around the optical axis 7 of the optical unit 1 and/or. the receiving unit 2 arranged, like it from Fig. 2 is more recognizable. The transmitting elements 3 are to emitting light of a frequency formed, which is again receiptable of the detecting unit 2. Light in the sense of this application can cover any optical radiation, for example infrared radiation, visible light or UV-RADIATION. General one is to be understood the bottom term light in the sense of this application each optical radiation, by which a pattern can become illuminated and a corresponding image of the remitted radiation of the detecting unit can become 2 detected.

The optical unit 1, which is detecting unit 2 and the transmitting elements 3 in a common housing 4 arranged, in whose rear portion a control and an evaluating unit formed as microprocessor are 5 arranged.

The transmitting elements 3 are in each case in groups 6 so summarized that those are controllable in each case to a group 6 belonging transmitting elements 3 over the control and evaluating unit 5 simultaneous, however from the transmitting elements 3 of the other groups 6 separate to emitting light. During in Fig. 1 exemplarily in each case three of transmitting elements 3 to a group 6 summarized are, are any summary of transmitting elements 3 to a group 6 possible. For example also each transmitting element 3 for itself can form alone a group 6 or be able to do it for different groups 6 to also overlap itself.

In a training procedure in each case the groups become 6, D. h. all transmitting elements 3 of a group 6, by the control and evaluating unit 5 successively to emitting light the driven, so that for example a different shade throw on the illuminated pattern originates in to dependent from the straight driven group 6. The images detected of the detecting unit 2 over the optical unit 1 and/or. characteristic features of these images become 6 stored for each group and after all groups became 6 once driven, the stored images become and/or. Features by the control and evaluating unit 5 on their suitability for the recognition of the detected pattern checked. Become evaluated for the pattern the characteristic features of the detected images, for example shade throw, reflectances and/or contrast transitions.

That group 6, which becomes with the evaluation as for the recognition of the pattern at the best suitable classified, becomes stored as group of references 6' characterized and. If necessary the next-best groups of the transmitting elements can become 3 determined and as downstream groups of references 6'', 6''' stored also in an other evaluation.

In the normal operation, the so called pattern recognition enterprise, the first exclusive transmitting elements 3 of the group of references of 6 become ' emitting light the driven, since in this case the probability of recognition is highest.

If no sufficient probability of recognition is given due to geometric properties or certain rem eating ion characteristics of

the pattern, then subsequent or the several downstream groups of references of 6'', 6''' by the control and evaluating unit 5 driven can become, whereby the probability of recognition for the predetermined pattern can become other increased. Is for example if variety from predetermined patterns a present to the comparison with the detected pattern and is after drive of the group of references of 6' only a limitation of the recognition on for example two of the predetermined patterns possible, then can by the other drive or the several downstream groups of references of 6'', 6''' - with simultaneous limitation on the already determined two predetermined patterns as allowable predetermined patterns - with high probability the proper pattern selected become.

Reference symbol list

- 1 optical unit
- 2 detection signal
- 3 transmitting elements
- 4 housings
- 5 control and evaluating unit
- 6 groups of the transmitting elements
- 6' group of references
- 6'', 6''' downstream groups of references

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1. Method to the image processing, with which an object by a variety of light sending transmitting elements (3) illuminated, which illuminated object of a receiving unit (2) detected will and which becomes of the receiving unit (2) detected image of the object at least partially evaluated, characterised in that in a training procedure successively different in each case groups (6) of the transmitting elements (3) emitting light the driven will become that certain on the basis predetermined selection criteria the group (6) of the transmitting elements (3) becomes as group of references (6 '), with whose drive during the training procedure for the recognition of the object at the best suitable image detected becomes, and that after terminating the training procedure seizing the trained object the transmitting elements (3) of the group of references (6 ') of driven become.

2. Process according to claim 1, characterised in that each group (6) an accurate transmitting element (3) covers.

▲ top 3. Process according to claim 1, characterised in that each group (6) at least a transmitting element (3) covers.

4. Method after one of the preceding claims, characterised in that the group (6) of the transmitting elements (3) as group of references (6 ') of selected becomes, with whose drive the detected image possesses the features most characteristic of the object.

5. Method after one of the preceding claims, characterised in that the group (6) of the transmitting elements (3) as group of references (6 ') of selected becomes, is optimum with whose drive a characteristic feature or several characteristic features of the detected object, for example an extreme value assumes.

6. Process according to claim 4 or 5, characterised in that as characteristic features shade throw, reflectances and/or contrast transitions evaluated becomes.

7. Method after one of the preceding claims, characterised in that the group (6) of the transmitting elements (3) as group of references (6 ') of selected becomes, with whose drive the detected image possesses the highest contrast transitions.

8. Methods after one of the preceding claims, characterised in that for seizing the trained object of the exclusive transmitting elements (3) of the group of references (6 ') of driven become.

9. Method after one of the preceding claims, characterised in that during the training procedure in order of their suitability for the recognition of the object additional downstream groups of references (6 ", 6 ''') of certain will and that if necessary seizing the trained object after heading for the transmitting elements (3) of the group of references (6 ') the transmitting elements (3) become that immediate downstream group of references (6 ") and the transmitting elements (3) of other downstream groups of references (6 ''') of driven.

10. Method after one of the preceding claims, characterised in that the detected image of the object on at least partial correspondence with at least a predetermined reference image checked becomes.

11. Process according to claim 10, characterised in that with not sufficient correspondence of the detected image of the object with the predetermined reference image the detected image on at least partial correspondence with at least an other predetermined reference image checked becomes.

12. Process according to claim 10 or 11, characterised in that with sufficient correspondence an object recognition signal generated becomes.

13. Optoelectronic device to the image processing with a variety of light sending transmitting elements (3), which for lighting up an object formed and arranged are, and with a detecting unit (2), with which the illuminated object detected

and into a digital image is convertible, in particular to the performing the method after one of the preceding claims, characterised in that the transmitting elements (3) in different groups (6) summarized are, whereby the transmitting elements of a group (6) are controllable common in each case, however separate of the transmitting elements (3) of the other groups (6) to emitting light.

14. Optoelectronic device according to claim 13, characterised in that each group (6) an accurate transmitting element (3) covers.

15. At least optoelectronic device according to claim 13, characterised in that each group (6) a transmitting element (3) covers.

16. Optoelectronic device after one of the claims 13 to 15, characterised in that an optical unit (1) for illustrating the object on the detecting unit (2) provided is.

17. Optoelectronic device after one of the claims 13 to 16, characterised in that the transmitting elements (3) in particular concentric around the optical axis (7) of the detecting unit and/or around the optical unit (1) of the detecting unit (2) around arranged are.

18. Optoelectronic device after one of the claims 13 to 17, characterised in that an evaluating unit (5) for examining the detected image of the object for at least partial correspondence with at least a predetermined reference image provided is.

19. Using a method after one of the claims 1 to 12 and/or an apparatus after one of the claims 13 to 18 to the pattern recognition and/or for picture improvement and/or to the segmentation and/or to the classification and/or for quality inspection and/or for measurement and/or for Lageprüfung and/or for surface testing.

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